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# LCM ENGINEERING SPECIFICATION

| | |
|---|---|
| *MODEL | LC420EUA |
| SUFFIX | AEM1 |
| Update | Dec.15, 2011 |

( ) **Preliminary Specification**

( ● ) **Final Specification**

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# RECORD OF REVISIONS

| Revision No. | Revision Date | Page | Description |
|---|---|---|---|
| 0.1 | Oct 07, 2011 | - | Preliminary Specification (First Draft) |
| 1.0 | Dec.15,2011 | 4 | Power consumption(Total & LED Driver) is corrected |
| | | 4 | Outline Dimension is corrected |
| | | 6 | Electrical Characteristics are corrected |
| | | 13 | SOE Width & Timing is corrected |
| | | 17 | Optical characteristics are corrected |
| | | 22,23 | Mechanical drawing is corrected |
| | | 28 | Cancel US patent |
| | | - | **Final Specification** |

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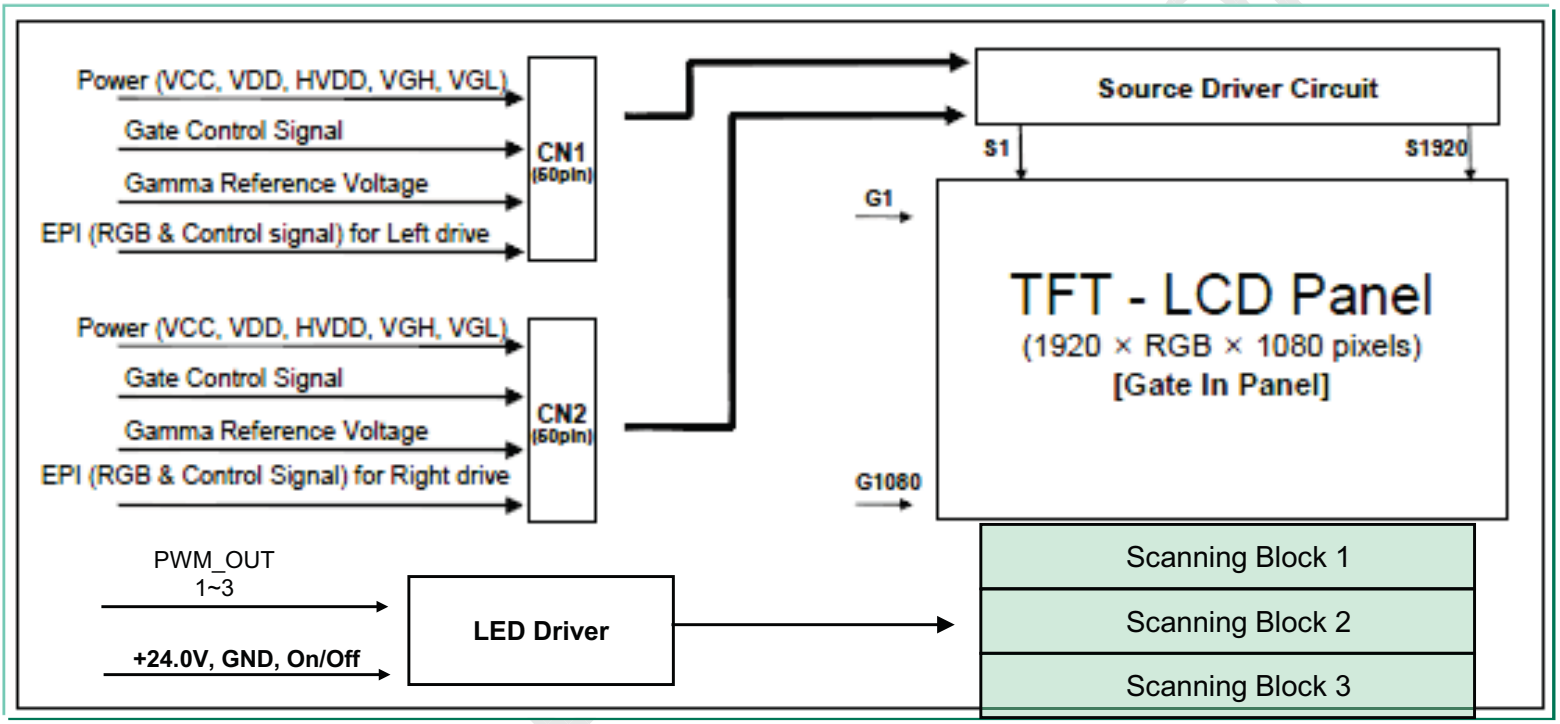
## 1. General Description

The LC420EUA is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode (LED) backlight system . The matrix employs a-Si Thin Film Transistor as the active element.
It is a transmissive display type which is operating in the normally black mode. It has a 42.02inch diagonally measured active display area with WUXGA resolution (1080 vertical by 1920 horizontal pixel array).
Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arrayed in vertical stripes.
Gray scale or the luminance of the sub-pixel color is determined with a 8-bit gray scale signal for each dot.
Therefore, it can present a palette of more than 1.67M(ture) colors.
It is intended to support LCD TV, PCTV where high brightness, super wide viewing angle, high color gamut, high color depth and fast response time are important.




## General Features

| | |
|---|---|
| Active Screen Size | 42.02inches(1067.31mm) diagonal |
| Outline Dimension | 960.4(H) × 560.4(V)X23.1mm(D) (Typ.) |
| Pixel Pitch | 0.4845 mm x 0.4845 mm |
| Pixel Format | 1920 horiz. by 1080 vert. Pixels, RGB stripe arrangement |
| Color Depth | 8bit, 16.7 Million colors |
| Luminance, White | 360 cd/m$^2$ (Center 1point ,Typ.) |
| Viewing Angle (CR>10) | Viewing angle free ( R/L 178 (Min.), U/D 178 (Min.)) |
| Power Consumption | Total 54.1W(TBD) (Typ.) [Logic=8.6W(TBD) , LED Driver=45.5W(ExtVbr_B=100% )] |
| Weight | 7.0(TBD) Kg (Typ.) |
| Display Mode | Transmissive mode, Normally black |
| Surface Treatment | Hard coating(2H), Anti-glare treatment of the front polarizer (Haze 10%) |



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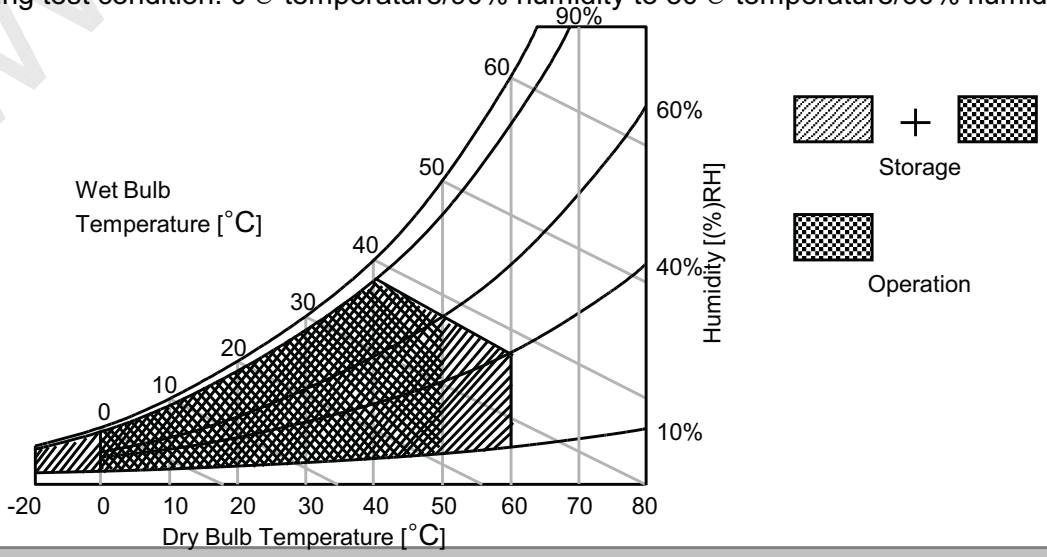
## 2. Absolute Maximum Ratings

The following items are maximum values which, if exceeded, may cause faulty operation or permanent damage to the LCD module.

**Table 1. ABSOLUTE MAXIMUM RATINGS**

| Parameter | Symbol | Value | | Unit | Note |
|---|---|---|---|---|---|
| | | Min | Max | | |
| Logic&EPI Power Voltage | VCC | -0.5 | +2.2 | VDC | 1 |
| Gate High Voltage | VGH | +18.0 | +30.0 | VDC | |
| Gate Low Voltage | VGL | -8.0 | -4.0 | VDC | |
| Source D-IC Analog Voltage | VDD | -0.3 | +18.0 | VDC | |
| Gamma Ref. Voltage (Upper) | VGMH | ½VDD-0.5 | VDD+0.5 | VDC | |
| Gamma Ref. Voltage (Low) | VGML | -0.3 | ½ VDD+0.5 | VDC | |
| Panel Front Temperature | TSUR | - | +68 | ˚C | 4 |
| Operating Temperature | TOP | 0 | +50 | ˚C | 2,3 |
| Storage Temperature | TST | -20 | +60 | ˚C | |
| Operating Ambient Humidity | HOP | 10 | 90 | %RH | |
| Storage Humidity | HST | 10 | 90 | %RH | |

Note
1. Ambient temperature condition (Ta = 25 ± 2 ˚C )
2. Temperature and relative humidity range are shown in the figure below. Wet bulb temperature should be Max 39 ˚C and no condensation of water.
3. Gravity mura can be guaranteed below 40℃ condition.
4. The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 68 ℃ with LCD module alone in a temperature controlled chamber. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 68 ℃. The range of operating temperature may degrade in case of improper thermal management in final product design.
5. The storage test condition:-20℃ temperature/90% humidity to 60℃ temperature/40% humidity ; the operating test condition: 0℃ temperature/90% humidity to 50℃ temperature/60% humidity.



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## 3. Electrical Specifications

It requires two kind of power inputs.
One is employed to power for the LCD circuit. The other Is used for the LED backlight circuit.

### 3-1. Electrical Characteristics

**Table 2. DC ELECTRICAL CHARACTERISTICS**

| Parameter | Symbol | Condition | MIN | TYP | MAX | Unit | Note |
|---|---|---|---|---|---|---|---|
| Logic & EPI Power Voltage | VCC | - | 1.62 | 1.8 | 1.98 | VDC | |
| Logic High Level Input Voltage | VIH | - | 1.4(TBD) | - | VCC | VDC | |
| Logic Low Level Input Voltage | VIL | - | 0 | - | 0.4(TBD) | VDC | |
| Source D-IC Analog Voltage | VDD | - | 16.5 | 16.7 | 16.9 | VDC | |
| Half Source D-IC Analog Voltage | H_VDD | - | 8.15 | 8.35 | 8.55 | VDC | 6 |
| Gamma Reference Voltage | $V_{GMH}$ | (GMA1 ~ GMA9) | H_VDD+0.2 (TBD) | - | VDD-0.2 (TBD) | VDC | |
| | $V_{GML}$ | (GMA10 ~ GMA18) | 0.2 | - | H_VDD-0.2V | VDC | |
| Common Voltage | Vcom | Reverse | 6.58 | 6.88 | 7.18 | V | |
| EPI input common voltage | VCM | LVDS Type | 0.8(TBD) | VCC/2 | VCC-0.6-Vdiff/2(TBD) | V | 5 |
| EPI Input eye diagram | Veye | - | 90(TBD) | - | - | mV | |
| EPI input differential voltage | Vdiff | - | 150(TBD) | - | 500(TBD) | mV | |
| Gate High Voltage | VGH | @ 25℃ | 27.7 | 28 | 28.3 | VDC | |
| | | @ 0℃ | 29.7 | 30 | 30.3 | VDC | |
| Gate Low Voltage | VGL | – | -5.2 | -5.0 | -4.8 | VDC | |
| GIP Bi-Scan Voltage | VGI_P VGI_N | - | VGL | - | VGH | VDC | |
| GIP Refresh Voltage | VGH even/odd | - | VGL | - | VGH | V | |
| GIP Start Pulse Voltage | VST | - | VGL | - | VGH | V | |
| GIP Operating Clock | GCLK | - | VGL | - | VGH | V | |
| Total Power Current | ILCD | - | - | 528 | 688 | mA | 1 |
| Total Power Consumption | PLCD | - | - | 6.34 | 8.23 | Watt | 1 |

Note:

1. The specified current and power consumption are under the $V_{LCD}$=12V., 25 ± 2°C, $f_V$=60Hz condition whereas mosaic pattern(8 x 6) is displayed and $f_V$ is the frame frequency.
2. The above spec is based on the basic model.
3. All of the typical gate voltage should be controlled within 1% voltage level
4. Ripple voltage level is recommended under ±5% of typical voltage
5. In case of EPI signal spec, refer to Fig 2 for the more detail.
6. HVDD Voltage level is half of VDD and it should be between Gamma9 and Gamma10.



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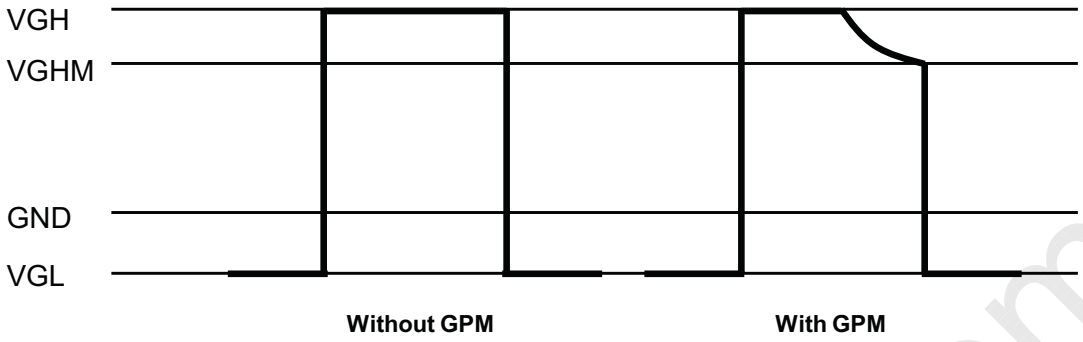


**FIG. 1 Gate Output Wave form without GPM and with GPM**

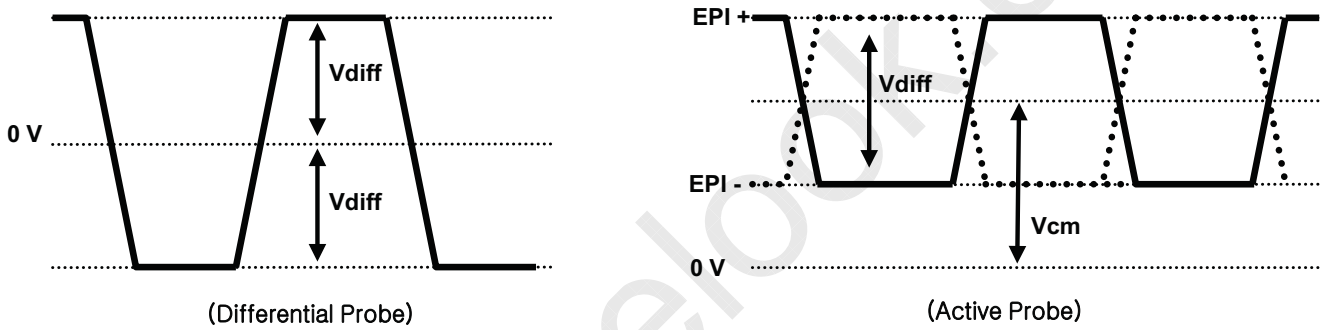


**FIG. 2-1 EPI Differential signal characteristics**

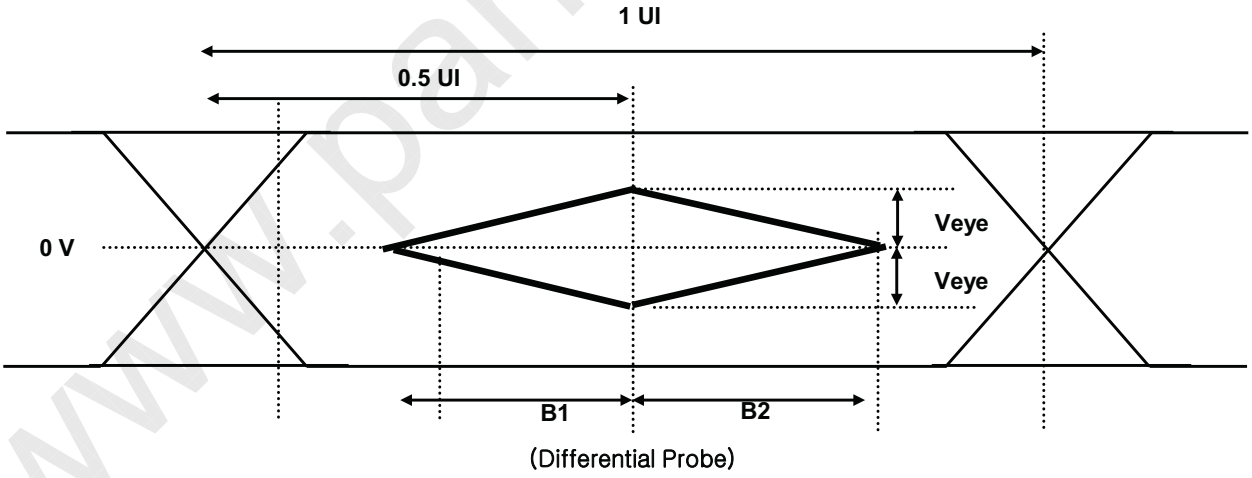


**FIG. 2-2 Eye Pattern of EPI Input**

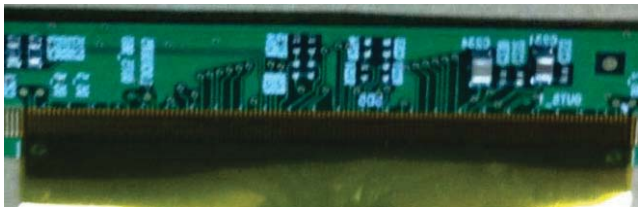

**FIG. 3 Measure point**



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**Table 3. ELECTRICAL CHARACTERISTICS (Continue)**

| Parameter | | | Symbol | Values | | | Unit | Notes |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| LED Driver : | | | | | | | | |
| Power Supply Input Voltage | | | VBL | 22.8 | 24.0 | 25.2 | Vdc | 1 |
| Power Supply Input Current | | | IBL | - | 1.9 | 2.1 | A | 1 |
| Power Supply Input Current (In-Rush) | | | In-rush | - | - | 3.5 | A | VBL = 22.8V<br>ExtV$_{BR-B}$ = 100% |
| Power Consumption | | | PBL | - | 45.5 | 49.8 | W | 1 |
| Input Voltage for Control System Signals | On/Off | On | V on | 2.5 | - | 5.0 | Vdc | |
| | | Off | V off | -0.3 | 0.0 | 0.7 | Vdc | |
| LED : | | | | | | | | |
| Life Time | | | | 30,000 | | | Hrs | 2 |

Notes :

1. Electrical characteristics are determined after the unit has been 'ON' and stable for approximately 60 minutes at 25±2°C. The specified current and power consumption are under the typical supply Input voltage 24Vand VBR (ExtVBR-B : 100%), it is total power consumption.
2. The life time (MTTF) is determined as the time which luminance of the LED is 50% compared to that of initial value at the typical LED current (ExtVBR-B :100%) on condition of continuous operating in LCM state at 25±2°C.



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## 3-2. Interface Connections

This LCD module employs two kinds of interface connection, two 50-pin FFC connector are used for the module electronics.

### 3-2-1. LCD Module

-LCD Connector (CN1): TF06L-50S-0.5SH (Manufactured by HRS) or Compatible

**Table 3-1. MODULE CONNECTOR(CN1) PIN CONFIGURATION**

| No | Symbol | Description | No | Symbol | Description |
|---|---|---|---|---|---|
| 1 | LTD_OUT | LTD OUTPUT | 26 | GND | Ground |
| 2 | NC | No Connection | 27 | EPI2- | EPI Receiver Signal(2-) |
| 3 | GCLK1 | GIP GATE Clock 1 | 28 | EPI2+ | EPI Receiver Signal(2+) |
| 4 | GCLK2 | GIP GATE Clock 2 | 29 | GND | Ground |
| 5 | GCLK3 | GIP GATE Clock 3 | 30 | GND | Ground |
| 6 | GCLK4 | GIP GATE Clock 4 | 31 | EPI1- | EPI Receiver Signal(1-) |
| 7 | GCLK5 | GIP GATE Clock 5 | 32 | EPI1+ | EPI Receiver Signal(1+) |
| 8 | GCLK6 | GIP GATE Clock 6 | 33 | GND | Ground |
| 9 | VGI_N | GIP Bi-Scan (Normal =VGL Rotate = VGH) | 34 | VCC | Logic & EPI Power Voltage |
| 10 | VGI_P | GIP Bi-Scan (Normal =VGH Rotate = VGL) | 35 | NC | No Connection |
| 11 | VGH_ODD | GIP Panel VDD for Odd GATE TFT | 36 | LOCKOUT3 | LOCKOUT3 |
| 12 | VGH_EVEN | GIP Panel VDD for Even GATE TFT | 37 | NC | No Connection |
| 13 | VGL | GATE Low Voltage | 38 | GND | Ground |
| 14 | VST | VERTICAL START PULSE | 39 | GMA 18 | GAMMA VOLTAGE 18 (Output From LCD) |
| 15 | GIP_Reset | GIP Reset | 40 | GMA 16 | GAMMA VOLTAGE 16 |
| 16 | VCOM_L_FB | VCOM Left Feed-Back Output | 41 | GMA 15 | GAMMA VOLTAGE 15 |
| 17 | VCOM_L | VCOM Left Input | 42 | GMA 14 | GAMMA VOLTAGE 14 |
| 18 | GND | Ground | 43 | GMA 12 | GAMMA VOLTAGE 12 |
| 19 | VDD | Driver Power Supply Voltage | 44 | GMA 10 | GAMMA VOLTAGE 10 (Output From LCD) |
| 20 | VDD | Driver Power Supply Voltage | 45 | GMA 9 | GAMMA VOLTAGE 9 (Output From LCD) |
| 21 | H_VDD | Half Driver Power Supply Voltage | 46 | GMA 7 | GAMMA VOLTAGE 7 |
| 22 | GND | Ground | 47 | GMA 5 | GAMMA VOLTAGE 5 |
| 23 | EPI3- | EPI Receiver Signal(3-) | 48 | GMA 4 | GAMMA VOLTAGE 4 |
| 24 | EPI3+ | EPI Receiver Signal(3+) | 49 | GMA 3 | GAMMA VOLTAGE 3 |
| 25 | GND | Ground | 50 | GMA 1 | GAMMA VOLTAGE 1(Output From LCD) |

Note :

1. Please refer to application note for details.
   (**GIP** & **Half VDD & Gamma Voltage setting**)



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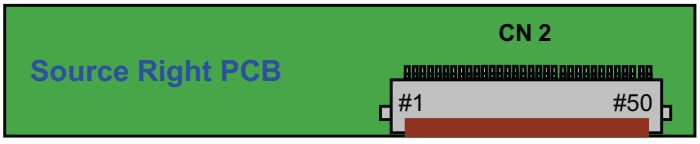
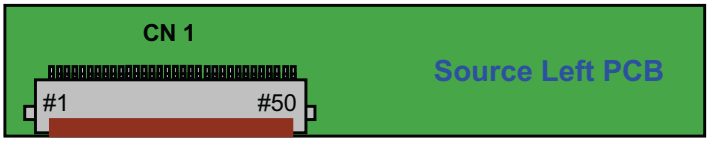
-LCD Connector (CN1): TF06L-50S-0.5SH (Manufactured by HRS) or Compatible

**Table 3-2. MODULE CONNECTOR(CN2) PIN CONFIGURATION**

| No | Symbol | Description | | No | Symbol | Description |
|---|---|---|---|---|---|---|
| 1 | GMA 1 | GAMMA VOLTAGE 1 (Output From LCD) | | 26 | GND | Ground |
| 2 | GMA 3 | GAMMA VOLTAGE 3 | | 27 | EPI1- | EPI Receiver Signal(4-) |
| 3 | GMA 4 | GAMMA VOLTAGE 4 | | 28 | EPI1+ | EPI Receiver Signal(4+) |
| 4 | GMA 5 | GAMMA VOLTAGE 5 | | 29 | GND | Ground |
| 5 | GMA 7 | GAMMA VOLTAGE 7 | | 30 | H_VDD | Half Driver Power Supply Voltage |
| 6 | GMA 9 | GAMMA VOLTAGE 9 (Output From LCD) | | 31 | VDD | Driver Power Supply Voltage |
| 7 | GMA 10 | GAMMA VOLTAGE 10 (Output From LCD) | | 32 | VDD | Driver Power Supply Voltage |
| 8 | GMA 12 | GAMMA VOLTAGE 12 | | 33 | GND | Ground |
| 9 | GMA 14 | GAMMA VOLTAGE 14 | | 34 | VCOM_R | VCOM Right Input |
| 10 | GMA 15 | GAMMA VOLTAGE 15 | | 35 | VCOM_R_FB | VCOM Right Feed-Back Output |
| 11 | GMA 16 | GAMMA VOLTAGE 16 | | 36 | GIP_Reset | GIP Reset |
| 12 | GMA 18 | GAMMA VOLTAGE 18 (Output From LCD) | | 37 | VST | VERTICAL START PULSE |
| 13 | GND | Ground | | 38 | VGL | GATE Low Voltage |
| 14 | LOCKOUT6 | LOCKOUT6 | | 39 | VGH_EVEN | GIP Panel VDD for Even GATE TFT |
| 15 | LOCKIN3 | LOCKIN3 | | 40 | VGH_ODD | GIP Panel VDD for Odd GATE TFT |
| 16 | NC | No Connection | | 41 | VGI_P | GIP Bi-Scan (Normal =VGH Rotate = VGL) |
| 17 | VCC | Logic & EPI Power Voltage | | 42 | VGI_N | GIP Bi-Scan (Normal =VGL Rotate = VGH) |
| 18 | GND | Ground | | 43 | GCLK6 | GIP GATE Clock 6 |
| 19 | EPI6- | EPI Receiver Signal(6-) | | 44 | GCLK5 | GIP GATE Clock 5 |
| 20 | EPI6+ | EPI Receiver Signal(6+) | | 45 | GCLK4 | GIP GATE Clock 4 |
| 21 | GND | Ground | | 46 | GCLK3 | GIP GATE Clock 3 |
| 22 | GND | Ground | | 47 | GCLK2 | GIP GATE Clock 2 |
| 23 | EPI5- | EPI Receiver Signal(5-) | | 48 | GCLK1 | GIP GATE Clock 1 |
| 24 | EPI5+ | EPI Receiver Signal(5+) | | 49 | NC | No Connection |
| 25 | GND | Ground | | 50 | LTD_OUT | LTD OUTPUT |

Note : 1. Please refer to application note for details.
(**GIP** & **Half VDD & Gamma Voltage setting**)



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### 3-2-2. Backlight Module

Master

-LED Driver Connector

: 20022WR - H14B2(Yeonho) or compatible

- Mating Connector

: 20022HS - 14B2 or compatible

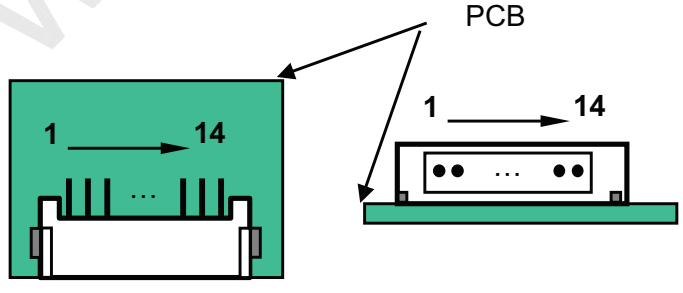
**Table 5-1. LED DRIVER CONNECTOR PIN CONFIGURATION**

| Pin No | Symbol | Description | Note |
|---|---|---|---|
| 1 | VBL | Power Supply +24.0V | |
| 2 | VBL | Power Supply +24.0V | |
| 3 | VBL | Power Supply +24.0V | |
| 4 | VBL | Power Supply +24.0V | |
| 5 | VBL | Power Supply +24.0V | |
| 6 | GND | Backlight Ground | |
| 7 | GND | Backlight Ground | |
| 8 | GND | Backlight Ground | 1 |
| 9 | GND | Backlight Ground | |
| 10 | GND | Backlight Ground | |
| 11 | Status | Back Light Status | 2 |
| 12 | VON/OFF | Backlight ON/OFF control | |
| 13 | NC | Don't care | |
| 14 | NC | Don't care | |

Notes :1. GND should be connected to the LCD module's metal frame.

2. Normal : Low (under 0.7V) / Abnormal : Open

◆ Rear view of LCM

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### 3-2-2. Backlight Module

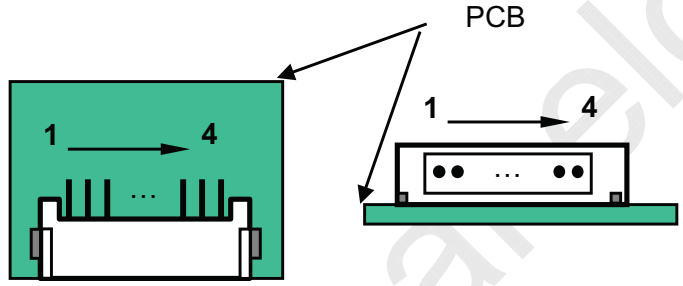
LED Driver Connector
: 10031HR-H04L_Black (YEONHO)

**Table 5-2. LED DRIVER CONNECTOR PIN CONFIGURATION**

| Pin No | Symbol | Description | Note |
|---|---|---|---|
| 1 | GND | Ground | 1 |
| 2 | SCAN3 | PWM 3 | |
| 3 | SCAN2 | PWM 2 | |
| 4 | SCAN1 | PWM 1 | |

Notes :1. GND should be connected to the LCD module's metal frame.

◆ Rear view of LCM

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## 3-3. Signal Timing Specifications

### Table 4. Timing Requirements

| Parameter | Symbol | Condition | Min | Typ | Max | Unit | Note |
|---|---|---|---|---|---|---|---|
| Unit Interval | UI | - | 0.59(TBD) | - | - | ns | |
| DLL Lock time | Tlock | - | 1.6(TBD) | - | 200(TBD) | Us | Fig 4 |
| Effective Veye width time | B1&B2 | - | 0.25(TBD) | - | - | UI | Fig. 2 |
| SSC | Vspread | @100KHz | - | - | 2(TBD) | % | |
| Receiver off to SOE rising time | tSOE_ Rising | | 5(TBD) | - | - | Packet | Fig.5 |
| SOE pulse width | tSOE_ Width | - | 4(TBD) | - | - | Packet | Fig.5 |
| SOE rising to 1st data time | tSOE_ DATA | - | 5(TBD) | - | - | Packet | Fig.5 |
| EPI Bandwidth | | - | 0.607(TBD) | - | 0.728(TBD) | GBPS | |

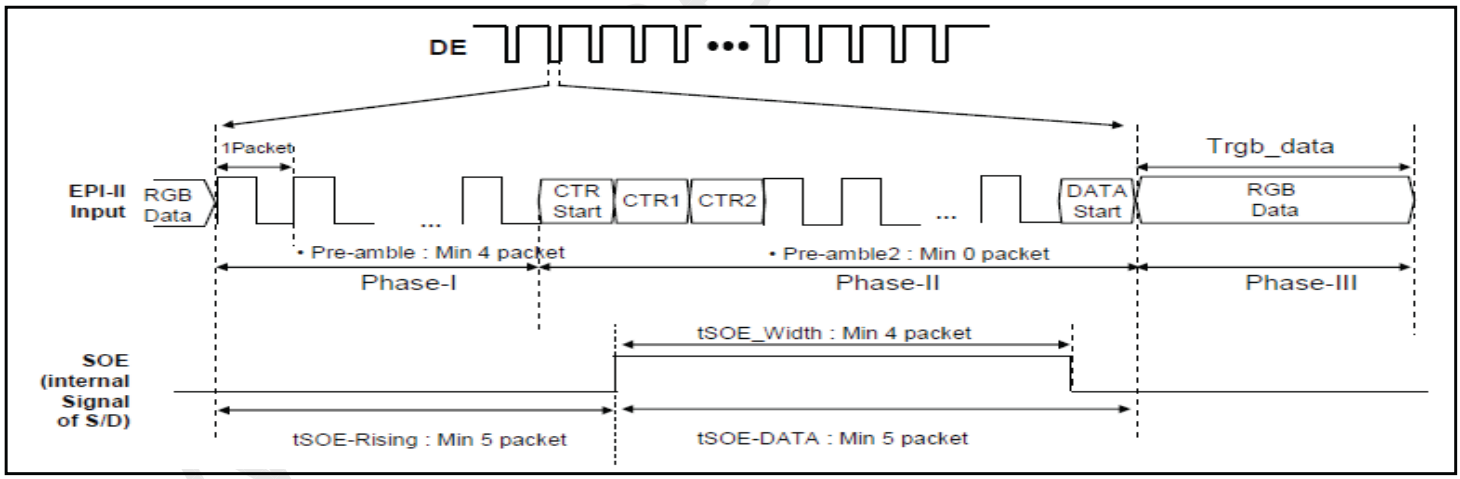


**FIG 4. SOE Width & Timing**



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### 3-4. Panel Pixel Structure

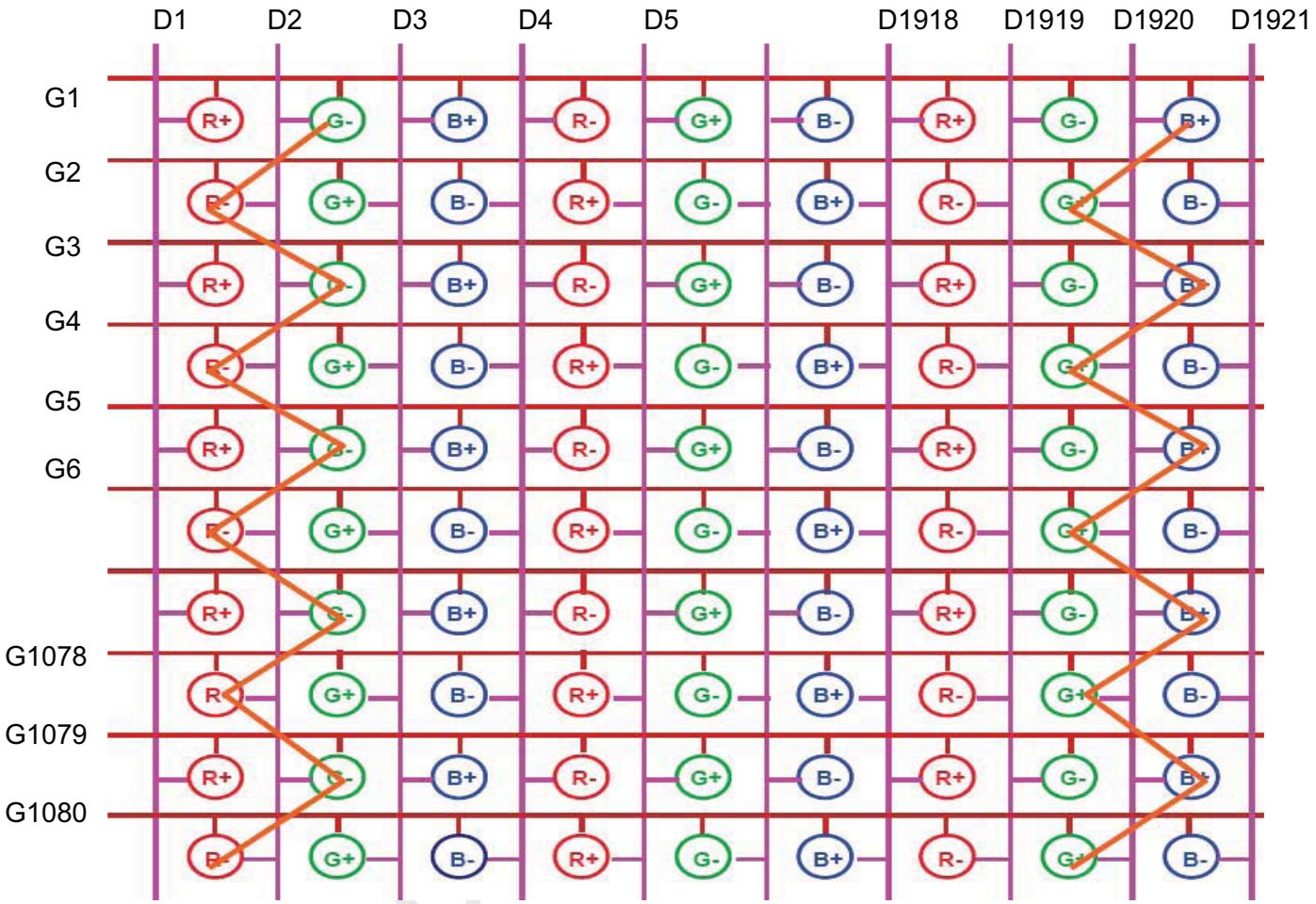


**FIG. 6 Panel Pixel Structure**



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## 3-7. Power Sequence

### 3-7-1. LCD Driving circuit

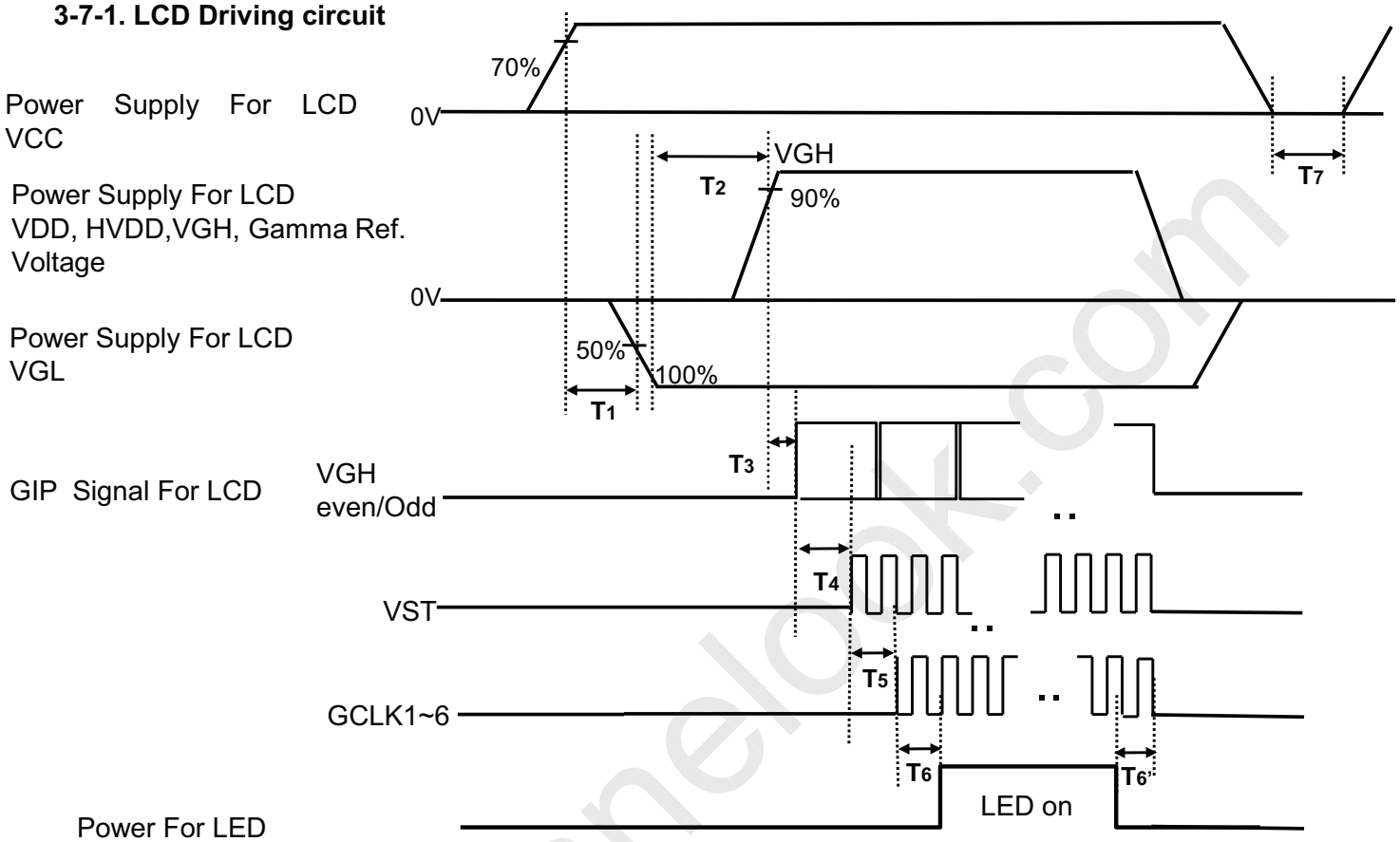


**Table 9. POWER SEQUENCE**

Ta= 25±2°C, fv=60Hz

| Parameter | Value | | | Unit | Notes |
|---|---|---|---|---|---|
| | Min | Typ | Max | | |
| T1 | 0.5 | | - | ms | |
| T2 | 0.5 | | - | ms | |
| T3 | 0 | | - | ms | |
| T4 | 10 | | - | ms | 2 |
| T5 | 0 | | - | ms | |
| T6 / T6' | 20 | | - | ms | 6 |
| T7 | 2 | | - | sec | |

Note : 1. Power sequence for Source D-IC must follow the Case1 & 2.
※ Please refer to Appendix Ⅲ for more details.
2. VGH Odd signal should be started "High" status and VGH even & odd can not be "High at the same time.
3. Power Off Sequence order is reverse of Power On Condition including Source D-IC.
4. GCLK On/Off Sequence
Normal : GCLK4 → GCLK5 → GCLK6 → GCLK1 → GCLK2 → GCLK3.
Reverse :GCLK3 → GCLK2 →GCLK1 → GCLK6 → GCLK5 → GCLK4.
5. VDD_odd/even transition time should be within V_blank
6. In case of T6', If there is no abnormal display, no problem



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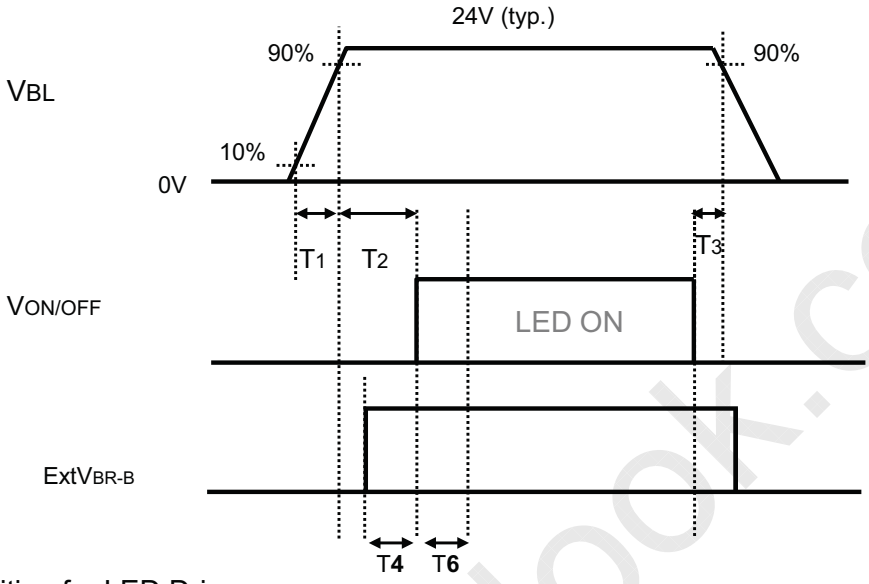
## 3-7. Power Sequence

### 3-7-2. Sequence for LED Driver

Power Supply For LED Driver




3-6-3. Dip condition for LED Driver

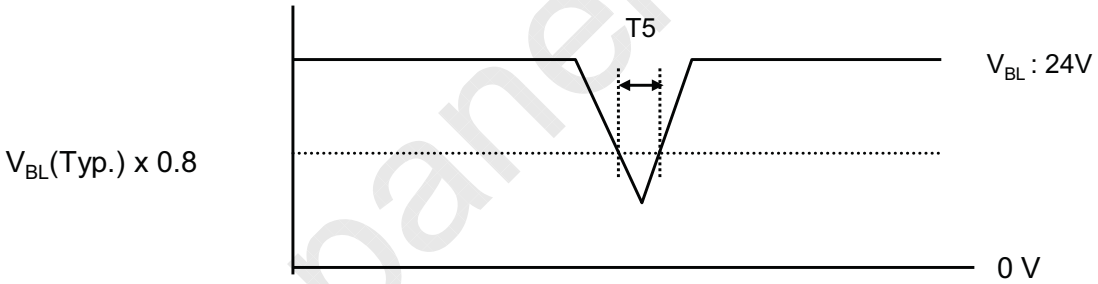



**Table 9. Power Sequence for LED Driver**

| Parameter | Values | | | Units | Remarks |
|---|---|---|---|---|---|
| | Min | Typ | Max | | |
| T1 | 20 | - | - | ms | 1 |
| T2 | 500 | - | - | ms | |
| T3 | 10 | - | - | ms | |
| T4 | 0 | - | - | ms | |
| T5 | - | - | 10 | ms | **$V_{BL}$**(Typ) x **0.8** |
| T6 | 500 | - | - | ms | 2 |

Notes : 1. T1 describes rising time of 0V to 24V and this parameter does not applied at restarting time.
Even though T1 is over the specified value, there is no problem if $I^2T$ spec of fuse is satisfied.
2. In T6 section, ExtVBR-B should be sustained from 5% to 100% .



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## 4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable in a dark environment at 25±2°C. The values are specified at distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 °.
FIG. 8 shows additional information concerning the measurement equipment and method.

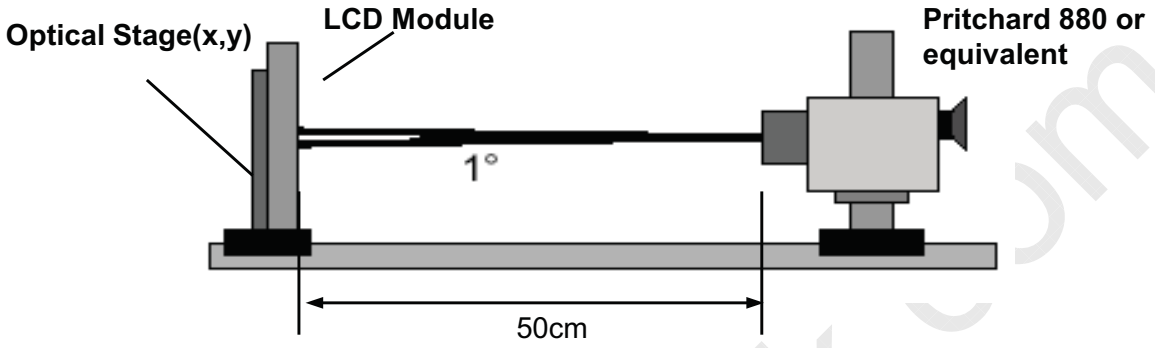


**FIG. 8 Optical Characteristic Measurement Equipment and Method**

**Table 10. OPTICAL CHARACTERISTICS**

Ta= 25±2°C, $V_{LCD}$=12.0V, fv=60Hz, Dclk=74.25MHz, **EXTV**BR-B =100%

| Parameter | | Symbol | | Value Min | Value Typ | Value Max | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Contrast Ratio | | CR | | 1000 | 1400 | - | | 1 |
| Surface Luminance, white | | $L_{WH}$ | 2D | 290 | 360 | | cd/m² | 2 |
| Luminance Variation | | $\delta_{WHITE}$ | 5P | | | 1.3 | | 3 |
| Response Time | Variation | Rising | | - | 8 | 12 | | 5 |
| | Gray to Gray (BW) | Falling | | - | 10 | 14 | ms | 4 |
| Color Coordinates [CIE1931] | RED | Rx | | Typ -0.03 | 0.635 | Typ +0.03 | | |
| | | Ry | | | 0.341 | | | |
| | GREEN | Gx | | | 0.320 | | | |
| | | Gy | | | 0.598 | | | |
| | BLUE | Bx | | | 0.154 | | | |
| | | By | | | 0.048 | | | |
| | WHITE | Wx | | | 0.279 | | | |
| | | Wy | | | 0.292 | | | |
| Color Temperature | | | | | 10,000 | | K | |
| Color Gamut | | | | | 68 | | % | |
| Viewing Angle | 2D (CR>10) | right(ϕ=0°) | θr (x axis) | 89 | - | - | degree | 6 |
| | | left (ϕ=180°) | θl (x axis) | 89 | - | - | | |
| | | up (ϕ=90°) | θu (y axis) | 89 | - | - | | |
| | | down (ϕ=270°) | θd (y axis) | 89 | - | - | | |
| Gray Scale | | | | - | - | - | | 7 |



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Note : 1. Contrast Ratio(CR) is defined mathematically as :

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

It is measured at center 1-point.

2. Surface luminance are determined after the unit has been 'ON' and 1 Hour after lighting the backlight in a dark environment at 25±2°C. Surface luminance is the luminance value at center 1-point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see the FIG. 9.

3. The variation in surface luminance , δ WHITE is defined as :

$$\delta \text{ WHITE(5P)} = \text{Maximum}(L_{on1}, L_{on2}, L_{on3}, L_{on4}, L_{on5}) / \text{Minimum}(L_{on1}, L_{on2}, L_{on3}, L_{on4}, L_{on5})$$

Where $L_{on1}$ to $L_{on5}$ are the luminance with all pixels displaying white at 5 locations .
For more information, see the FIG. 9.

4. Response time is the time required for the display to transit from G(N) to G(M) (Rise Time, $Tr_R$) and from G(M) to G(N) (Decay Time, $Tr_D$). For additional information see the FIG. 10. (N<M)

5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD module surface. For more information, see the FIG. 11.

6. Gray scale specification
Gamma Value is approximately 2.2. For more information, see the Table 11.

**Table 11. GRAY SCALE SPECIFICATION**

| Gray Level | Luminance [%] (Typ) |
|---|---|
| L0 | TBD |
| L15 | 0.27 |
| L31 | 1.04 |
| L47 | 2.49 |
| L63 | 4.68 |
| L79 | 7.66 |
| L95 | 11.5 |
| L111 | 16.1 |
| L127 | 21.6 |
| L143 | 28.1 |
| L159 | 35.4 |
| L175 | 43.7 |
| L191 | 53.0 |
| L207 | 63.2 |
| L223 | 74.5 |
| L239 | 86.7 |
| L255 | 100 |



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Measuring point for surface luminance & measuring point for luminance variation.

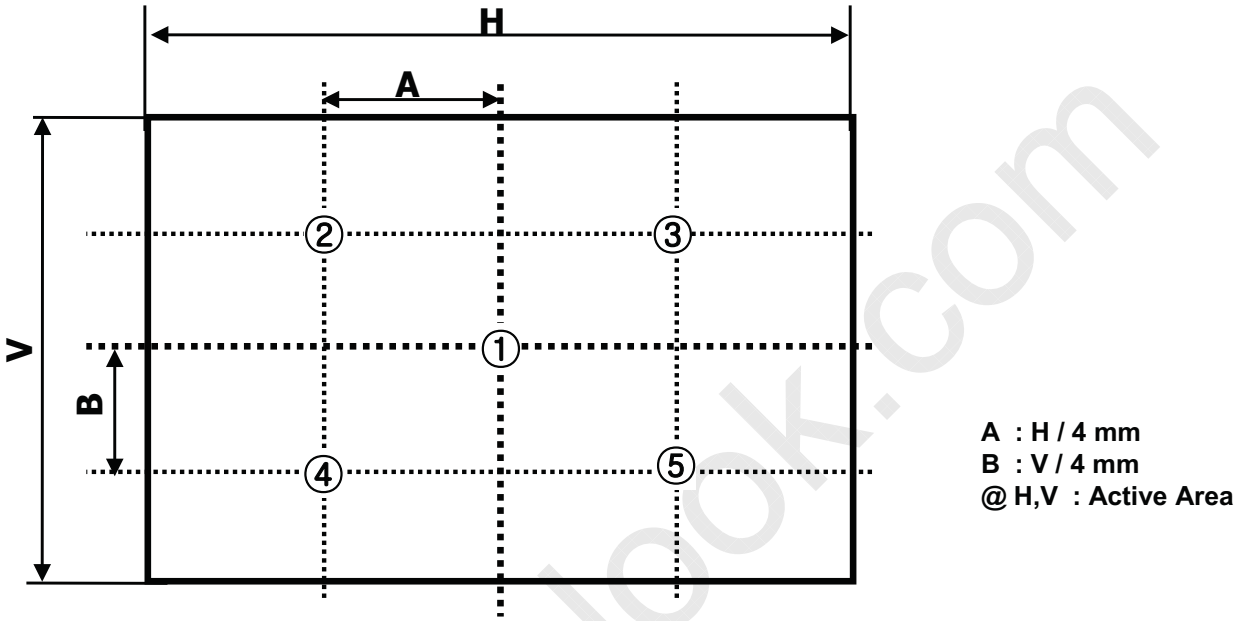


**FIG.9 5 Points for Luminance Measure**

Response time is defined as the following figure and shall be measured by switching the input signal for "Gray(N)" and "Gray(M)".

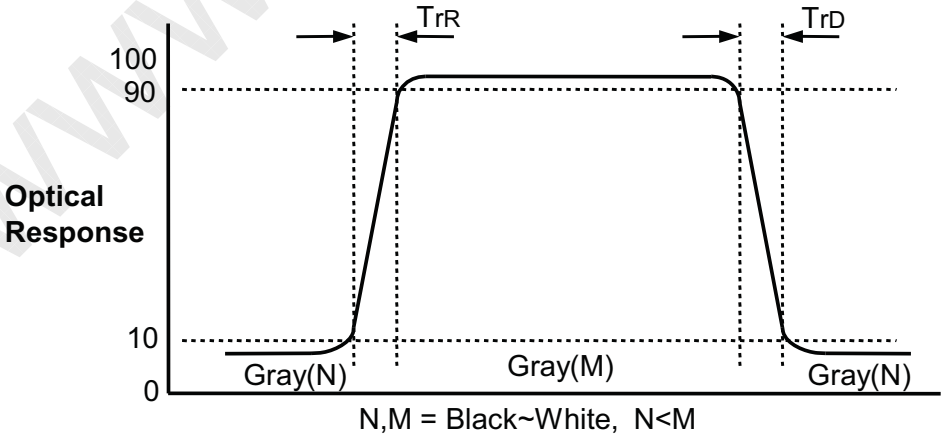


**FIG. 10 Response Time**



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Dimension of viewing angle range

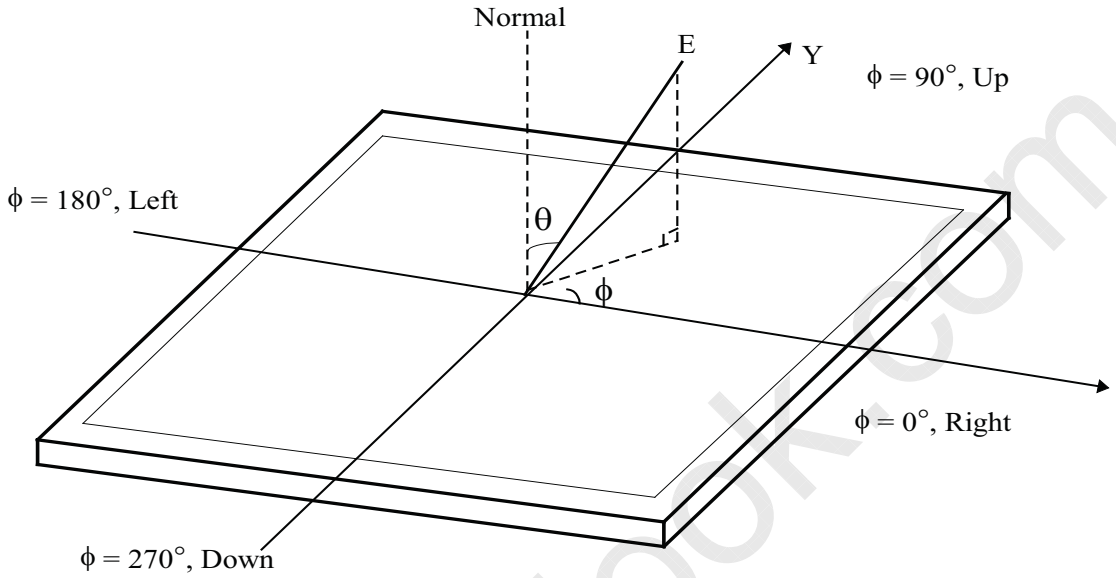


**FIG. 11 Viewing Angle**

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## 5. Mechanical Characteristics

Table 12 provides general mechanical characteristics.

**Table 12. MECHANICAL CHARACTERISTICS**

| Item | Value | |
|---|---|---|
| Outline Dimension | Horizontal | 960.4 mm |
| | Vertical | 560.0 mm |
| | Depth | 16.2 mm |
| Bezel Area | Horizontal | 938.6 mm (*1) |
| | Vertical | 531.5 mm |
| Active Display Area | Horizontal | 930.24 mm |
| | Vertical | 523.26 mm |
| Weight | 7.0 Kg (Typ.), 7.4 kg (Max.) | |

Note : Please refer to a mechanical drawing in terms of tolerance at the next page.

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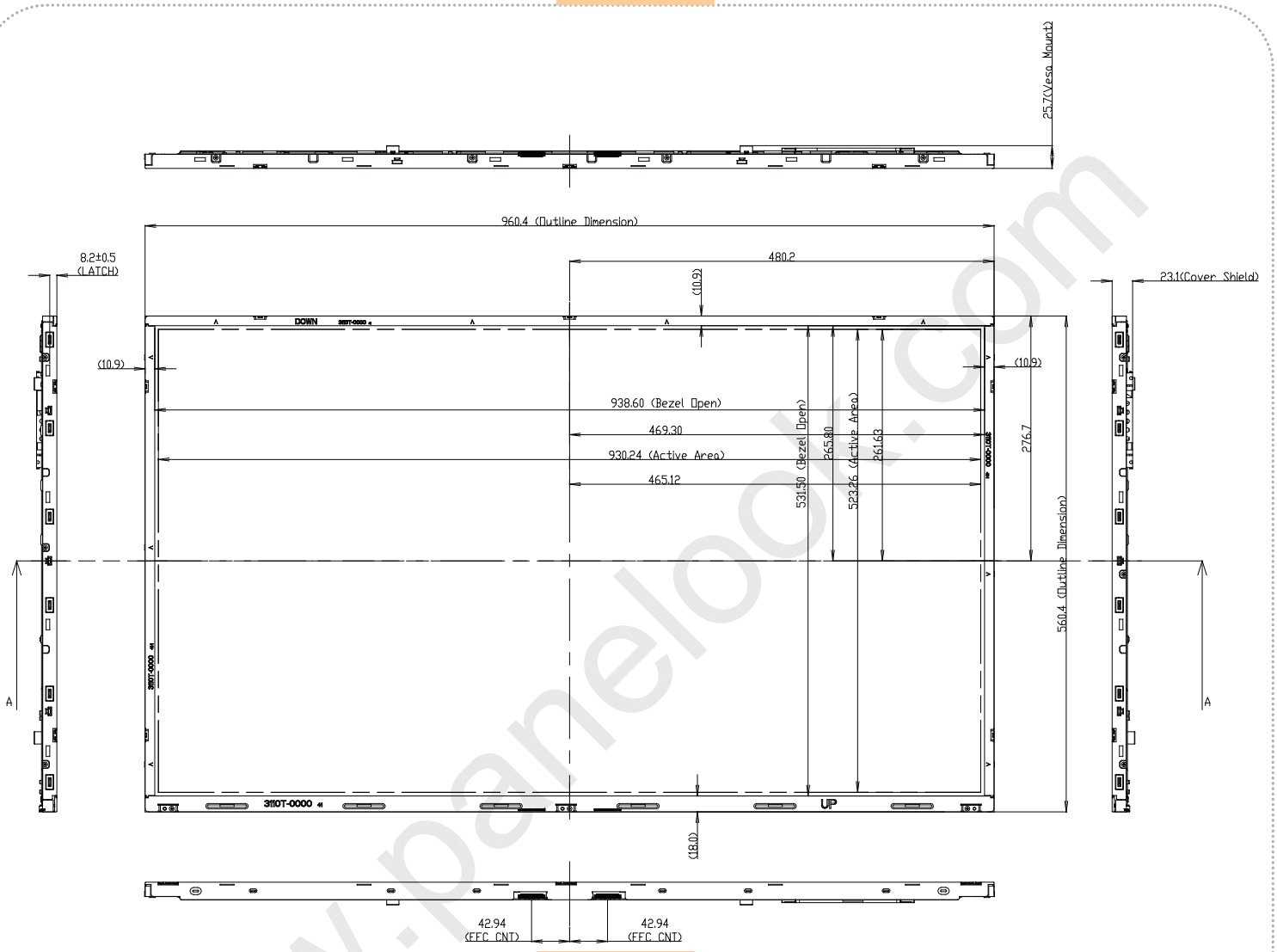
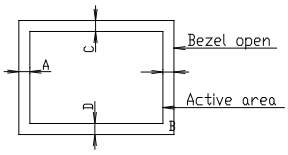
[ FRONT VIEW ]

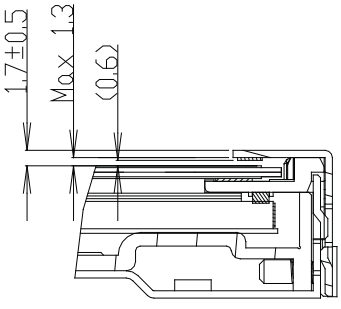
Set : Top




Set : Down

NOTES
1.UNSPECIFIED TOLERANCE IS ±1.0MM
2.TILT AND PARTIAL DISPOSITION TOLERANCE OF DISPLAY AREA AS FOLLOWING.
(1) Y-DIRECTION: | A-B | ≤1.5
(2) X-DIRECTION: | C-D | ≤1.5

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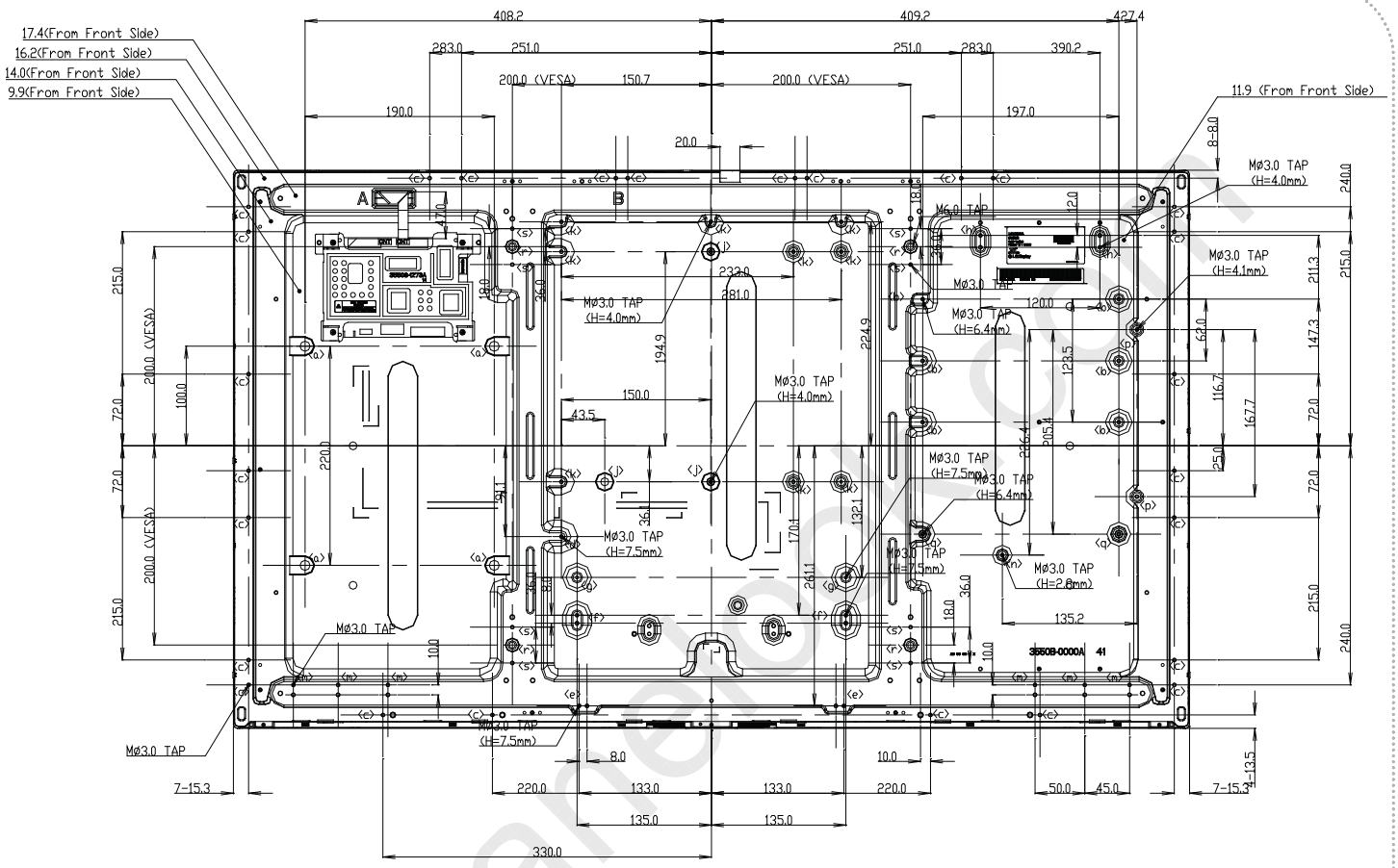
## [ REAR VIEW ]

**Set : Top**




**Set : Down**

| ITEM | TAP | Max Depth (mm) | Torque (Kgf.cm) | Notes |
|---|---|---|---|---|
| <a> | M3 | MAX 10.0 | MAX 8.0 | |
| <b> | M3 | MAX 6.0 | MAX 8.0 | |
| <c> | M3 | MAX 5.0 | MAX 8.0 | |
| <d> | M3 | MAX 7.0 | MAX 8.0 | |
| <e> | M4 | MAX 7.0 | MAX 10.0 | |
| <f> | M4 | MAX 7.0 | MAX 10.0 | |
| <g> | M4 | MAX 7.0 | MAX 10.0 | |
| <h> | M4 | MAX 3.5 | MAX 10.0 | |
| <j> | M3 | MAX 4.5 | MAX 8.0 | |
| <k> | M3 | MAX 4.5 | MAX 8.0 | |
| <m> | M3 | MAX 7.0 | MAX 8.0 | |
| <n> | M3 | MAX 4.0 | MAX 8.0 | |
| <p> | M3 | MAX 3.5 | MAX 8.0 | |
| <q> | M3 | MAX 6.0 | MAX 8.0 | |
| <r> | M6 | MAX 12.0 | | |
| <s> | M3 | MAX 7.0 | MAX 8.0 | |

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## 6. Reliability

**Table 13. ENVIRONMENT TEST CONDITION**

| No. | Test Item | Condition |
|---|---|---|
| 1 | High temperature storage test | Ta= 60°C 240h |
| 2 | Low temperature storage test | Ta= -20°C 240h |
| 3 | High temperature operation test | Ta= 50°C 50%RH 240h |
| 4 | Low temperature operation test | Ta= 0°C 240h |
| 5 | Humidity condition Operation | Ta= 40 °C ,90%RH |

Note : Before and after Reliability test, LCM should be operated with normal function.

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## 7. International Standards

### 7-1. LED Array - Safty

1. Laser (LED Backlight) Information

| |
|---|
| Class 1M LED Product<br>IEC60825-1 : 2001<br>Embedded LED Power (Class 1M) |

2. Caution
: LED inside.
Class 1M laser (LEDs) radiation when open.
Do not open while operating.

### 7-2. Environment

a) RoHS, Directive 2002/95/EC of the European Parliament and of the council of 27 January 2003

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## 8. Precautions

Please pay attention to the followings when you use this TFT LCD module.

### 8-1. Mounting Precautions

(1) You must mount a module using specified mounting holes (Details refer to the drawings).
(2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
(3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.
(4) You should adopt radiation structure to satisfy the temperature specification.
(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
(6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are detrimental to the polarizer.)
(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer
(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
(9) Do not open the case because inside circuits do not have sufficient strength.

### 8-2. Operating Precautions

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
V=±200mV(Over and under shoot voltage)
(2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
(3) Brightness depends on the temperature. (In lower temperature, it becomes lower.)
And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer
(4) Be careful for condensation at sudden temperature change.Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
(6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.
(7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.
(8) A screw which is fastened up the steels should be a machine screw.
(if not, it can causes conductive particles and deal LCM a fatal blow)
(9) Please do not set LCD on its edge.
(10) The conductive material and signal cables are kept away from LED driver inductor to prevent abnormal display, sound noise and temperature rising.



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## 8-3. Electrostatic Discharge Control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

## 8-4. Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

## 8-5. Storage

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
(2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.
(3) Storage condition is guaranteed under packing conditions.
(4) The phase transition of Liquid Crystal could be recovered if the LCM is released at the normal condition after the low or over the storage temperature.

## 8-6. Handling Precautions for Protection Film

(1) The protection film is attached to the bezel with a small masking tape.
When the protection film is peeled off, static electricity is generated between the film and polarizer.
This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
(2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
(3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

## 9-7. Operating condition guide

(1) The LCD product should be operated under normal conditions. Normal condition is defined as below;
- Temperature : 5 ~ 40 ℃
- Display pattern : continually changing pattern (Not stationary)
(2) If the product will be used in extreme conditions such as high temperature, display patterns or operation time etc..,
It is strongly recommended to contact LGD for Qualification engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems. The LCD product should be applied by global standard environment. (refer ETSI EN 300, IEC 60721)



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# APPENDIX- I

■ LCM Label

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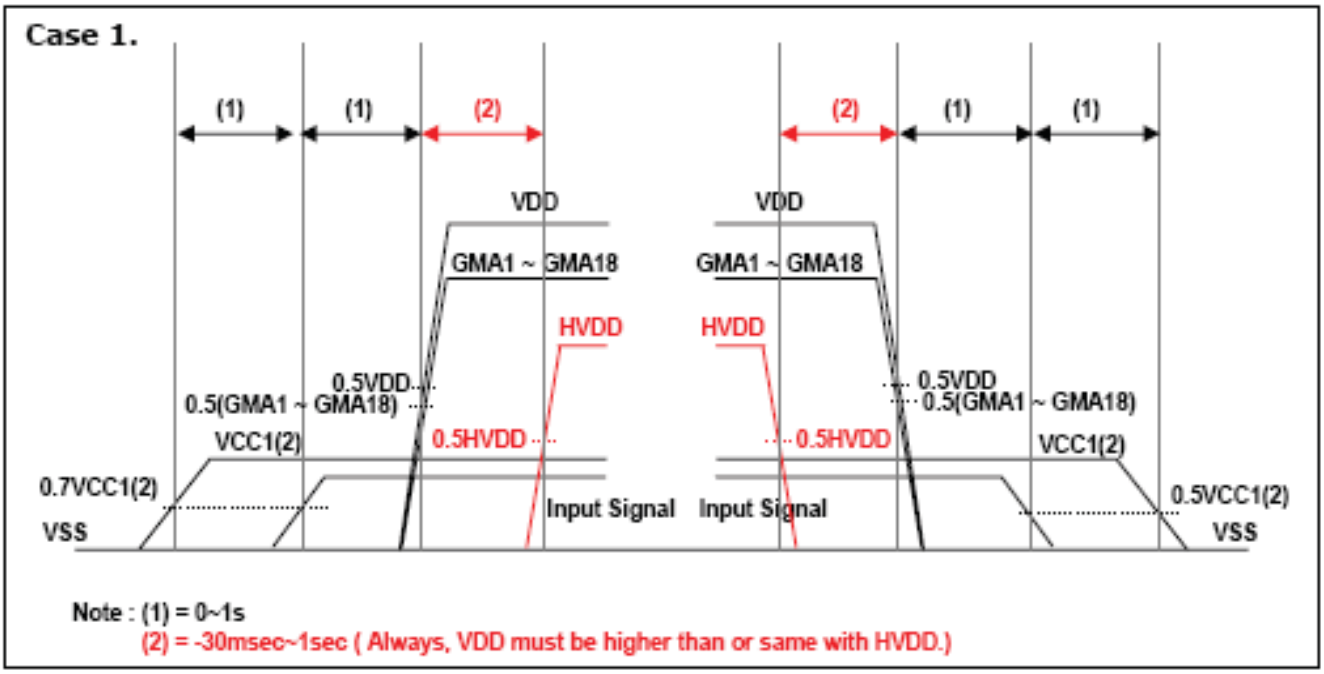
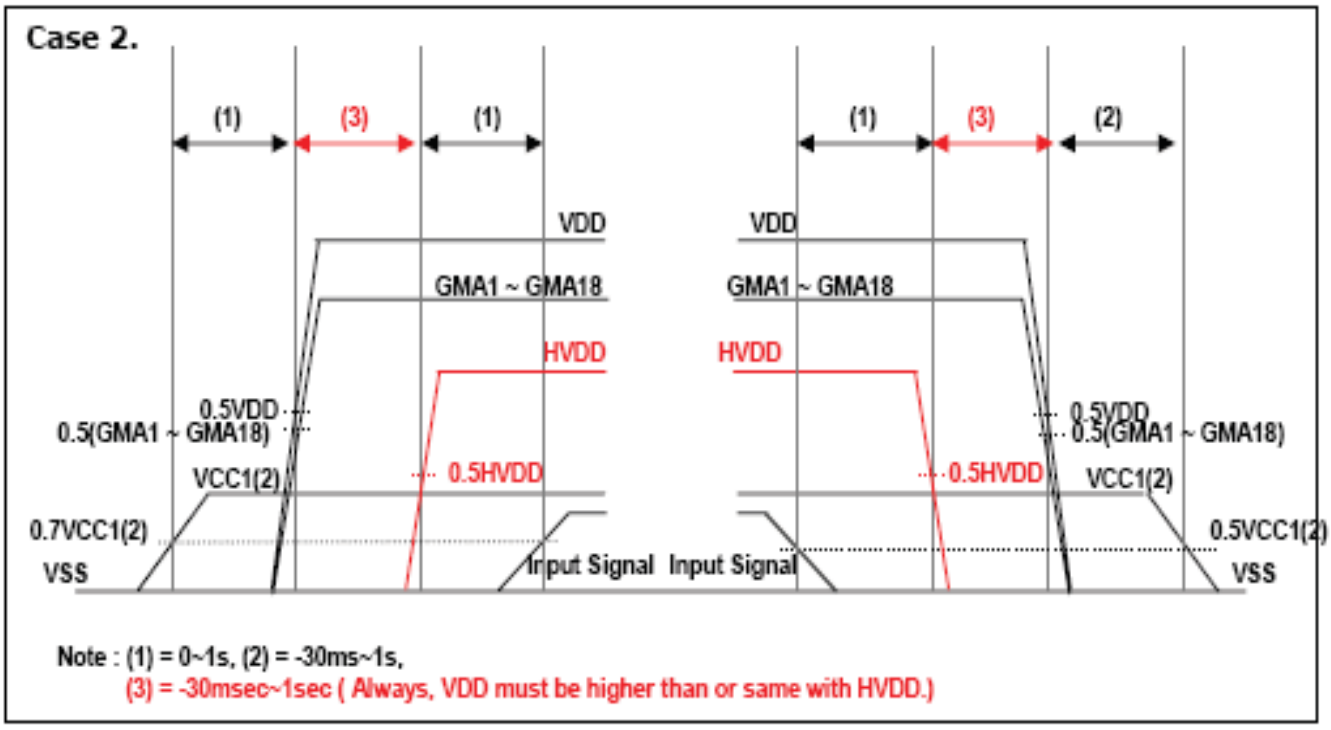
# APPENDIX- I I

■ LCM Source power sequence

**< Source power sequence >**




Note : (1) = 0~1s
(2) = -30msec~1sec ( Always, VDD must be higher than or same with HVDD.)




Note : (1) = 0~1s, (2) = -30ms~1s,
(3) = -30msec~1sec ( Always, VDD must be higher than or same with HVDD.)

**- Input Signal : SOE,POL,GSP,H_CONV,OPT_N**



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